

Heat: An Agent of Change

What We Know About Heat

TEACHER GUIDE

BACKGROUND INFORMATION

Although heat as a form of energy is typically taught in both lower and upper elementary science curricula, many misconceptions persist in secondary science students. Misconceptions must be addressed before effective new learning can occur.

This is an introductory class discussion that helps the teacher assess student understanding of the concept of heat. It will set the tone and allow you to determine how to proceed with the rest of this module. **Complete this first, whether you plan to complete all or only some of the subsequent activities.**

It is important to accept student input as it is given. If other students want to challenge a point, allow that to occur and encourage conversation among students. The “answers” will emerge from the activities in the remainder of this module.

STANDARDS ADDRESSED

Grades 5–8

Physical Science: [Transfer of Energy](#)

Grades 9–12

Physical Science: [Conservation of energy and the increase in disorder](#); [Interactions of energy and matter](#).

MATERIALS

Light bulb that is lit
Bunsen burner burning
Beaker of boiling water on hot plate

PROCEDURE

Have materials on the teacher desk or someplace where all of the students can observe them.

Say:

1. On the desk are things that are hot. Some are very hot. What are other examples of things that are hot?
Make a list of their examples on the board or on chart paper.

Emphasize that you are interested in reports of observable phenomena, not abstract concepts. Encourage your students to support their answers with examples, evidence, and explanations.

Ask:

1. What do these things have in common?
2. What is the meaning of the word hot?
3. What is the relationship of something that is hot with the idea of heat?
4. What are some things that heat can do?

Expect answers like: melts things, burns things, moves between things, changes the color of things, or makes things expand.

Ask:

5. How do we know heat is present in something?

Expect answers like: we can measure the temperature, the material expands, it burns our hands, or it burns up.

Ask:

6. If I wanted to add heat to something, how could I do it?

Expect answers like: put it in the Sun, put a flame under it, or rub it. Listen for answers suggesting a heat source transferring heat to the object, or some other form of energy being changed to heat energy.

Throughout this discussion, listen for clues to the level of student understanding. Do they generalize that heat changes things, sometimes reversibly, but not always? Do students use the terms *conductor* and *insulator* when they provide examples? Can they name the tools and technology used to measure heat? Do students define heat as molecular movement? Are they familiar with the very abstract concept that all matter is made of atoms and molecules?

Determine students' operational concept of energy and their level of knowledge about conservation of energy and transformation of energy between forms (mechanical, electrical, chemical, nuclear, as well as heat).

Say:

7. In your laboratory notebook, write the conditions that you believe must be present to increase the heat energy of an object.

Expect answers like: source of heat, a way to transmit the heat through the object, heat touching the object, or material that conducts heat.

Say:

8. In your laboratory notebook, write your definition of heat. We will refer to this definition as we do activities in this unit. You will be able to add to or change your definition as we learn more.

RESOURCES

<http://fy.chalmers.se/~f3aamp/teaching/wakalix.html>

This excerpt from Surely You're Joking, Mr. Feynmann! explains Richard Feynmann's ideas about teaching the concept of energy. It may be helpful to physical science teachers to consider these ideas when designing their classroom lessons.

<http://sprott.physics.wisc.edu/demobook/chapter2.htm>

This college professor has published a book of physics demonstrations with short historical explanations of concept development. This chapter is on heat.

<http://www.csn.net/~takinfo/faq/faq1.htm>

This website answers frequently asked questions about concepts related to heat. It's more than a glossary.

<http://www.mip.berkeley.edu/physics/bookcdx.html>

This website contains directions to duplicate the U.C. Berkeley Physics Department lecture demonstrations on properties of heat and matter.